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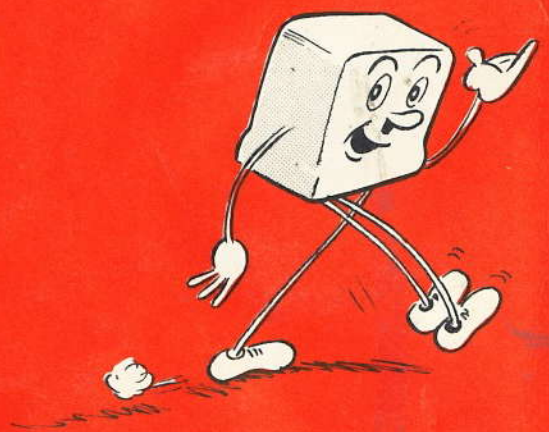

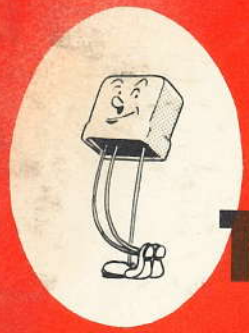

the TRANSISTOR and YOU

A Handbook for Radio and Electronics Amateurs on Semiconductor Devices and their Applications

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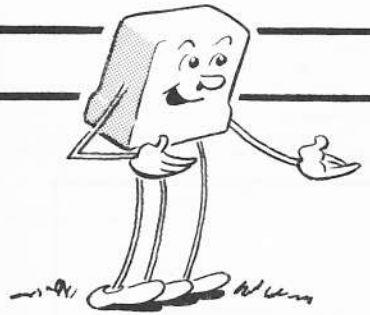


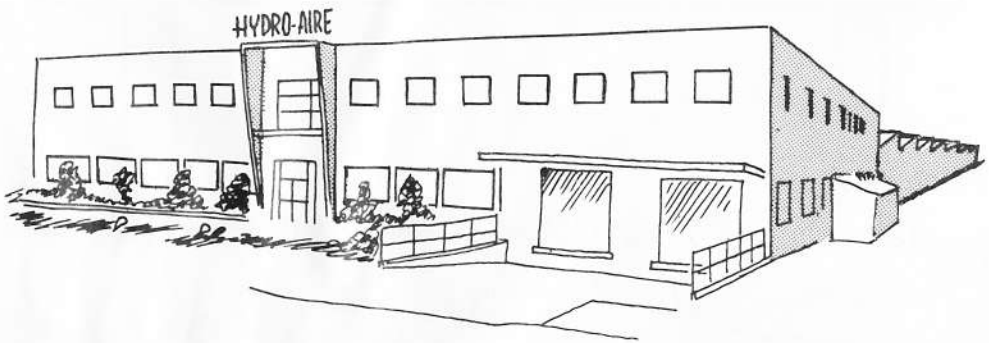
MEET HYDRO-AIRE

YOUR SOURCE FOR SEMICONDUCTOR EQUIPMENT FOR HAM USE

Hydro-Aire has been actively engaged in the manufacture of transistors under a Western Electric Company licensing agreement for several years. This agreement led to the setting up of a specialized Electronics Division at Hydro-Aire, fully staffed by highly qualified men who have at their disposal resources and facilities for research and development on the scale demanded by such an important project.

Hydro-Aire soon moved into the end product field of semiconductor engineering, with the express purpose of demonstrating to the electronics industry what the transistor could do, applicationwise, to replace the vacuum tube. It became the task of Hydro-Aire's Semiconductor Application Section to dispel the widespread illusion that this was just a question of pulling out a vacuum tube and inserting a transistor! Actually, as informed people like the average radio amateur are well aware, successful transistor application demands design technology which is not compatible with that of the vacuum tube. It is in this technology that Hydro-Aire has pioneered several notable developments: the first hermetically sealed transistor; the first transistor socket strips; and more recently has come the big news of Hydro-Aire's Bonded Barrier Transistor, a unit that finally meets the long-felt need for a high frequency transistor suitable for quantity production at a practical cost. At last the wholesale substitution of transistors for vacuum tubes is in sight!

Hydro-Aire's considerable research and production facilities are backed by the great resources of the Crane Co., Chicago.



SALUTE TO THE HAM!

Many of us here at Hydro-Aire have been active amateurs for years. Therefore, it goes without saying that this company is well aware of the importance of the HAM fraternity, and of the great service rendered by this enthusiastic group in pioneering and development in the electronic field of endeavor.

Hydro-Aire first notified amateur interests of the availability of its semiconductor products in an advertisement in the Catalogue Section of the Radio Amateur's Handbook, 1954 edition, page 94. We offered literature on the use of point contact transistors, particularly in the building of a miniaturized broadcast band receiver. The response was tremendous. Thousands of mailings went out, and it was reemphasized to us that the well-known fervor of the amateur radio experimenter was as strong as ever, if not stronger.

At this time Hydro-Aire completed a laboratory program which showed the junction transistor to be much more versatile than the point contact. In developing junction transistor circuitry we not only opened many uses in the commercial field but also made "ham" applications a practical reality. The result is this book.

We know the HAM fraternity is eager to keep abreast of semiconductor developments; and we intend to help all we can. In short, gentlemen: we salute you!

HERE'S HOW
THIS LITTLE BOOK IS MEANT
TO HELP YOU. . .

Into the fast-moving electronics industry has come a new word: semiconductors. It is no exaggeration to say that this is a development that opens up potentials in electronic technique that surpass our wildest pipe-dreams of several years ago.

As an active amateur and experimenter in this field you have undoubtedly followed the news about transistors and their applications with consuming interest. Obviously, since every true amateur is a "do-er", not just a mere reader — there's nothing you'd like better than to get your hands on some of these mighty little gadgets. The first transistors were expensive; but Hydro-Aire has beaten the cost problem with its production of the CQ-1, which is specifically designed to meet the need of amateurs and experimenters for a good quality transistor at a home workshop price. The CQ-1 is now available from many radio parts jobbers and distributors, so all you need is some basic information on transistor application to get you started — and you're off on the most fascinating trail since the invention of the vacuum tube!

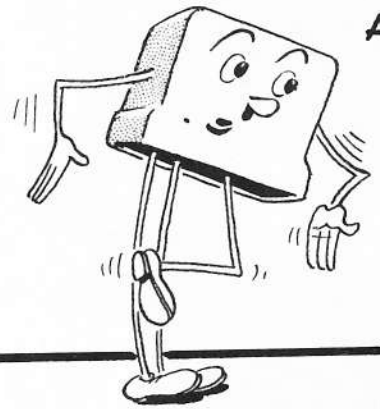
SO HERE'S GOOD LUCK IN YOUR DEALINGS WITH THAT FASCINATING FELLOW....

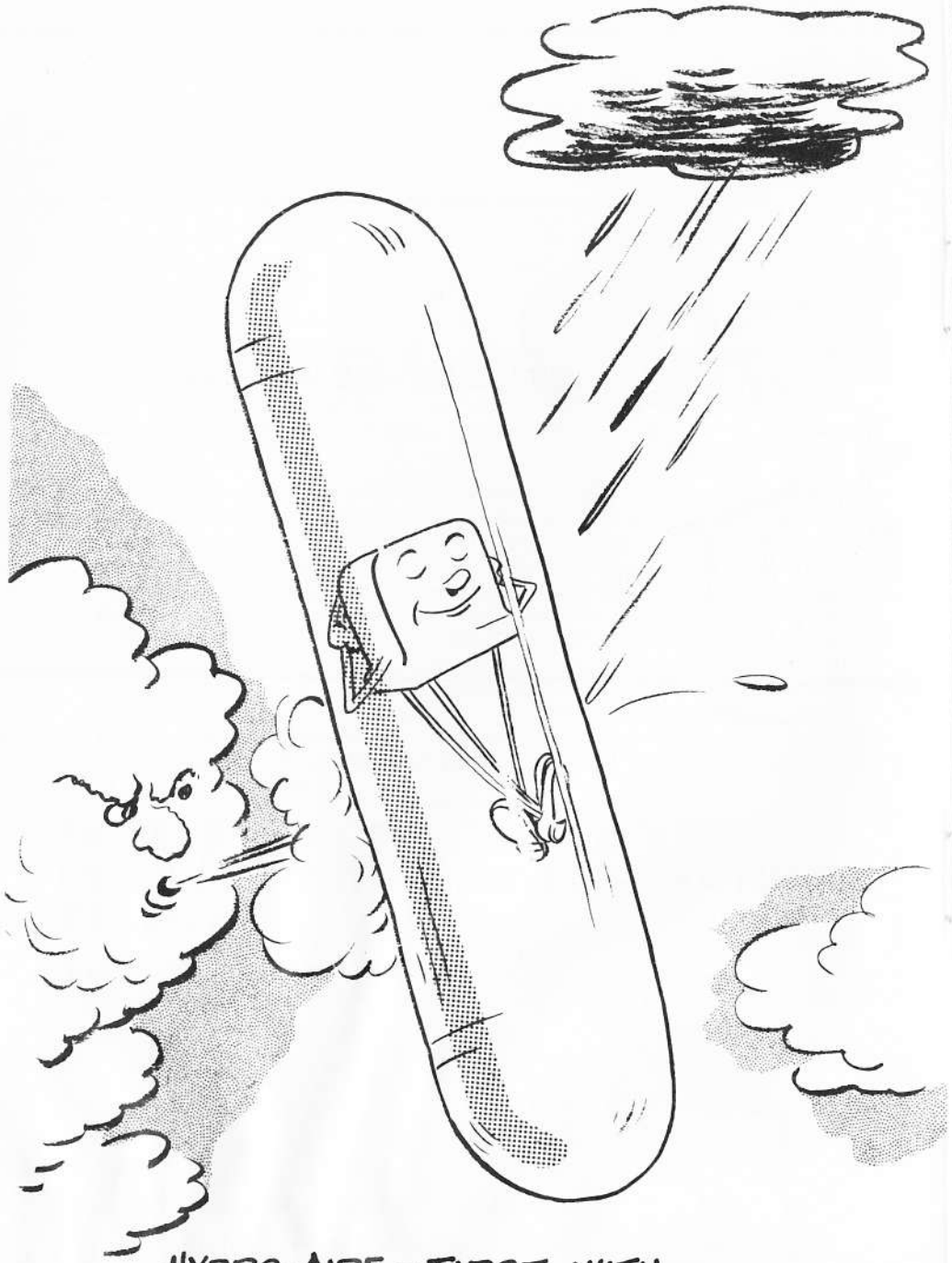
MR. TRANSISTOR!!

ELECTRONICS Division of HYDRO-AIRE, Inc.
3000 Winona Avenue, Burbank, California

If your local jobber does not yet stock Hydro-Aire Transistors, please write to us direct.

AND AWAY WE GO!....





HYDRO-AIRE - FIRST WITH HERMETICALLY SEALED TRANSISTORS.

HYDRO-AIRE JUNCTION TYPE "HAM" TRANSISTOR CQ-1 SPECIFICATIONS

DESCRIPTION:
The Type "CQ-1" Transistor is a PNP germanium junction transistor that is hermetically sealed for protection against adverse atmospheric conditions. It is specially constructed to withstand shock and vibration. Long leads are provided for solder connections, or the leads may be trimmed for use with standard sub-miniature tube sockets.

APPLICATIONS:
The Type "CQ-1" Transistor is designed for use in medium gain, low-to-medium power amateur radio applications.

MECHANICAL SPECIFICATIONS:
Mounting Position: Any.

The Transistor is housed in a metal case. Tin plated leads extend from the case through glass-to-metal seals.

ELECTRICAL DATA:

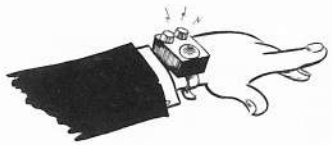
Maximum Ratings:	
Collector Dissipation	150 MW
Collector Voltage	−40 V
Collector Current	−10 MA
Ambient Temperature	50°C

TYPICAL OPERATING CHARACTERISTICS AT 25°C AMBIENT TEMPERATURE, F 2KC (COMMON BASE).

	CQ-1
Collector Voltage	−6
Emitter current	1.0
Current Amplification (Alpha), Min.	.90
Collector Resistance, Min. (Ohms)	500 K
Base Resistance, Max. (Ohms)	200
Emitter Resistance, Min. (Ohms)	30
Collector Cutoff Current, Max. (UA)	20
Noise Figure, 1 KC, Max. (DB)	33
Frequency Cutoff, (MC)	0.5
Maximum Power Gain, Common Emitter (DB)	30

A THREE-STAGE TRANSISTORIZED REGENERATIVE RADIO RECEIVER

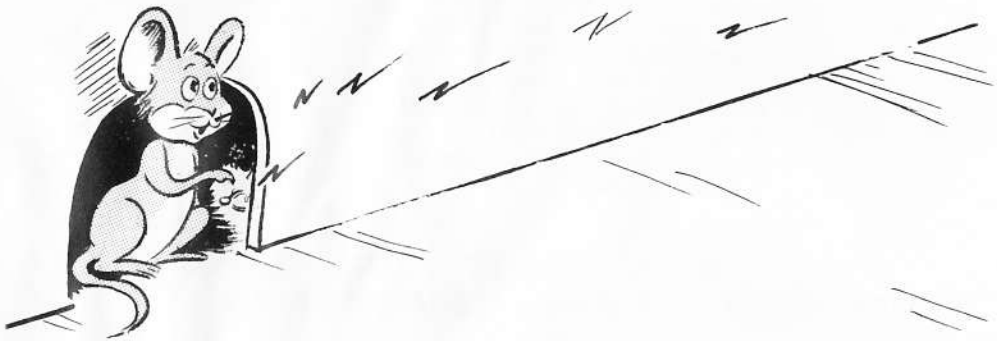
Some of the major advantages afforded by the use of transistors over their vacuum tube counterparts are low power consumption, instantaneous operation, small size, light weight and lack of thermal heat radiation. A quick look at these properties develops the thought that transistors are a natural for the Dick Tracy wristwatch receiver, or if your thinking runs more to the conservative side, at least a vest pocket version of an ether wave tapper. In either case your imagination would not be running too far afield as the size of today's transistorized equipment is not governed by the semiconductor components but rather by the lack of subminiature parts to meet a given circuit application.



The application of transistors to a vest pocket broadcast band radio receiver has intrigued Hydro-Aire engineers for some time. Basic design requirements were established to produce a unit that was extremely small and lightweight, employing a minimum of transistors. For this reason a regenerative circuit was developed in preference to the multistage superheterodyne.

As constructed at Hydro-Aire, this receiver is contained in a box 2" x 3" x ¾". This box houses the power supply consisting of hearing aid batteries; however, a loudspeaker, if one is employed, is external to the case.

The receiver has a tuning range from 650–1550 KC, a current drain of 2.5 ma and will give clear reception in this area of at least six stations. A 15-foot piece of wire serves as the antenna. Improved reception will result from using a ground.



The tuned circuit transformer is a loopstick. This component is modified by scramble winding the short antenna wire attached to the loopstick over the coil to form a secondary winding. Care must be taken to observe proper polarity and to keep the loopstick as far from the metal chassis as possible.

A Hydro-Aire type A-1 point contact transistor is used in the detector circuit of the receiver. The audio amplifier stages utilize Hydro-Aire CQ-1 junction type transistors.

In referring to the schematic diagram it will be noted that a 100 K resistor is used in the collector of the type A-1 transistor. The purpose of this resistor is to hold the collector current to a safe value when the potentiometer is at minimum resistance position.

The base resistor in the last stage may be chosen as a compromise between current drain and tone. In general, the lower values draw more current and attenuate the higher audio frequencies. A safe range of values is 330 K to 500 K ohms.

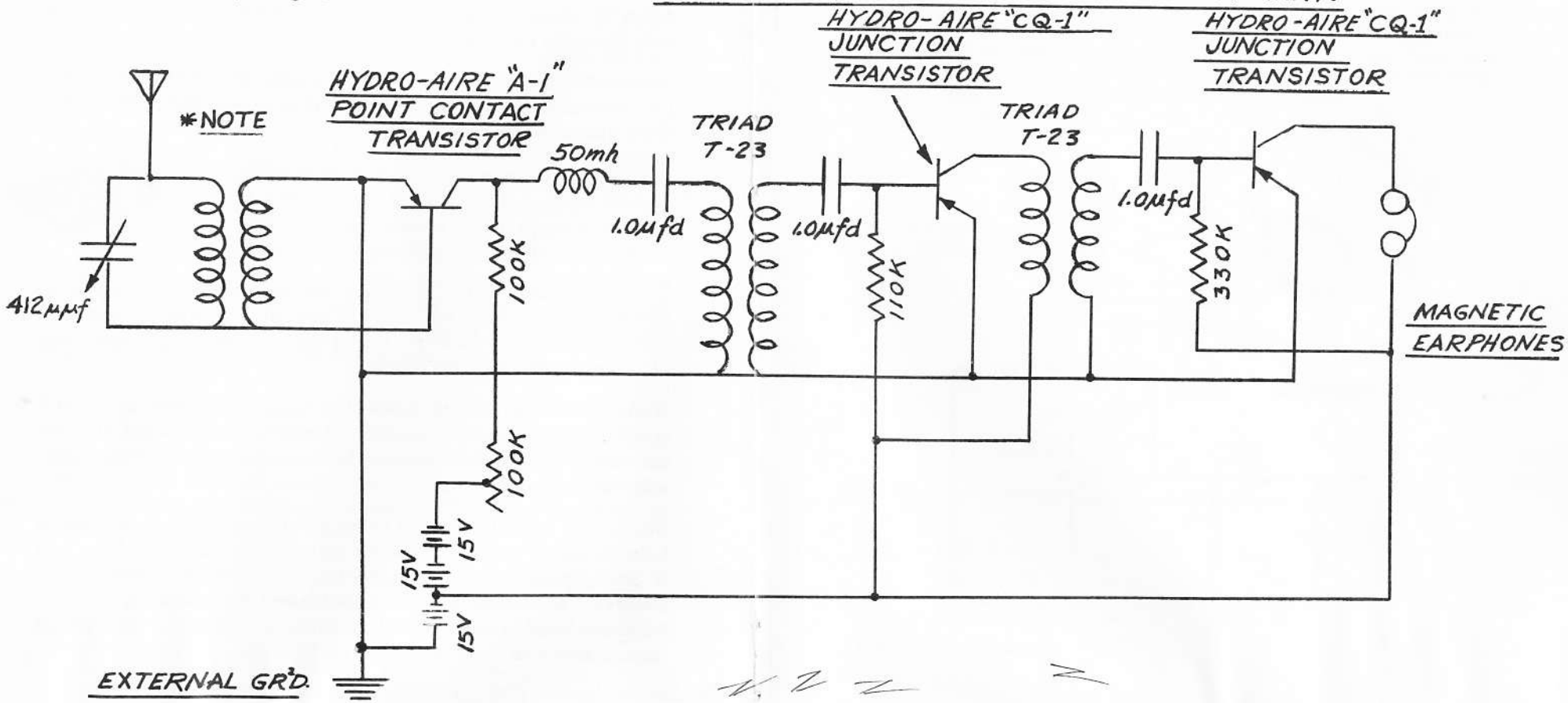
If the 330 K base resistor in the last stage is replaced by a 220 K resistor, sufficient output is produced to drive a 6" speaker; however, the current drain on the batteries becomes quite high and very markedly reduces battery life.

Normal care in lead dress and selection of resistors for a compromise between signal output and current drain will reward the builder with a small, personalized, selective and trouble-free radio receiver. Moreover, an appropriately designed tuned RF circuit for the low frequency amateur bands should produce a receiver of very unique construction with many utilitarian applications.

HYDRO-AIRE, INC.

TRANSISTORIZED RADIO RECEIVER

CP 1005



PARTS LIST FOR TRANSISTOR 3-STAGE REGENERATIVE RECEIVER

RESISTORS

1 100 K 1/2 W
1 110 K 1/2 W
1 330 K 1/2 W
1 100 K Variable with on-off switch

CONDENSERS

3 1 MFD Paper Tubular
1 412 MMF Tuning Condenser

TRANSFORMERS

2 Triad #T-23
1 Ferri-loopstick
1 50 MH – 100 MA Choke – Merit #BC-532

TRANSISTORS

1 Point Contact – Hydro-Aire #A-1
2 Junction – Hydro-Aire #CQ-1

BATTERIES

3 Eveready #411

LOW COST BROADCAST RECEIVER

The schematic of a semiconductor broadcast band receiver set forth below is much more simplified and consequently much *less costly* to build than the receiver covered by figure #1. Additional transistor stages of audio amplification may be added to provide loudspeaker operation should this feature be desired.

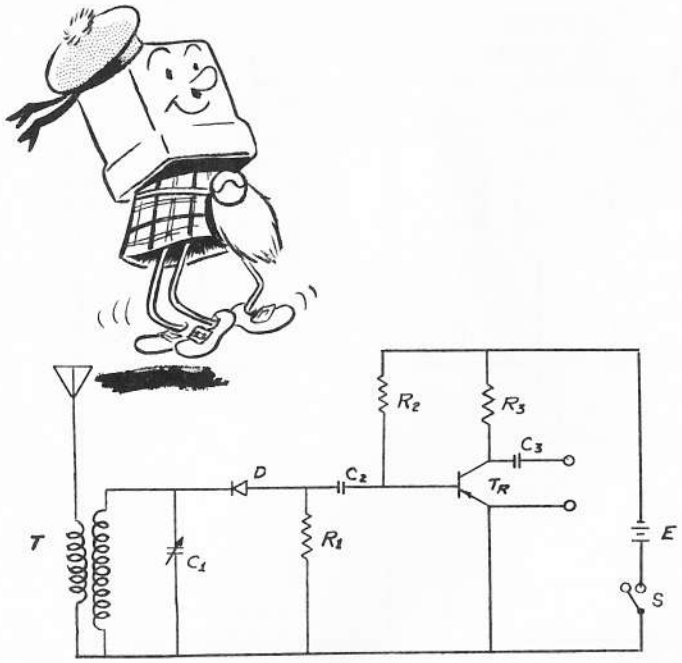


Figure 2

T_r = Hydro-Aire CQ-1, P-N-P Junct. Trans.
D = Hydro-Aire IN34A Germanium Diode
T = Standard Broadcast Band ANT. Coil
C_1 = 365 *mmfd*, Variable Capacitor
C_2 = 4 *mfd*, 10 Volt Electrolytic Cap.
C_3 = 4 *mfd*, 10 Volt Electrolytic Cap.
E = 6 Volts
S = SPST, ON–OFF Switch
R_1 = 10,000 Ω , ½ Watt, Carb. Res.
R_2 = 150,000Ω , ½ Watt, Carb. Res.
R_3 = 3300 Ω , ½ Watt, Carb. Res.

DYNAMIC MICROPHONE PREAMPLIFIER

Additional amplification for a dynamic microphone is readily obtainable from the preamplifier sketched below. This amplifier is not only easy and economical to build, but possesses a high utility value as well. The entire amplifier and power supply can be built into a package of approximately one cubic inch, making the unit an ideal accessory to mobile and portable equipment applications.

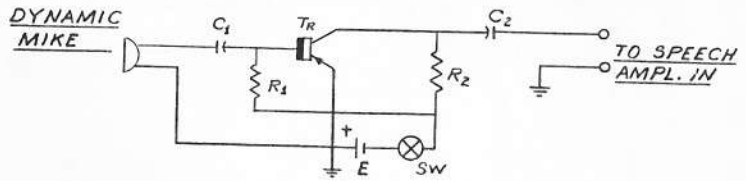


Figure 3

C_1, C_2 = 1 μf capacitor (midget metallized or tantalum)
R_1 = 100K Ω resistor
R_2 = 20K – 100K Ω resistor
T_r = Hydro-Aire CQ-1 junction transistor
E = 1.5 V Battery
SW = Switch

RADIOPHONE MONITOR

A variation of the broadcast band receiver depicted in figure #2 is contained below. This circuit adapts itself nicely for use as a radiophone transmission monitor. The LC circuit in the front end of the monitor should be designed to resonate in the "ham" bands where operation is desired. The transistor base resistor should be adjusted for 100 microamperes of collector current with no input signal present. The value of this resistor will be in the neighborhood of 100,000 ohms.

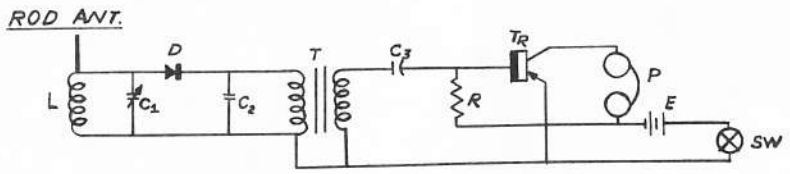


Figure 4

L, C_1 = Coil L and capacitor C_1 are chosen to tune to the carrier frequency of the transmitter

D = Hydro-Aire germanium diode IN34A

C_2 = .002 μf capacitor

T = 500 Ω primary 1K Ω secondary transformer

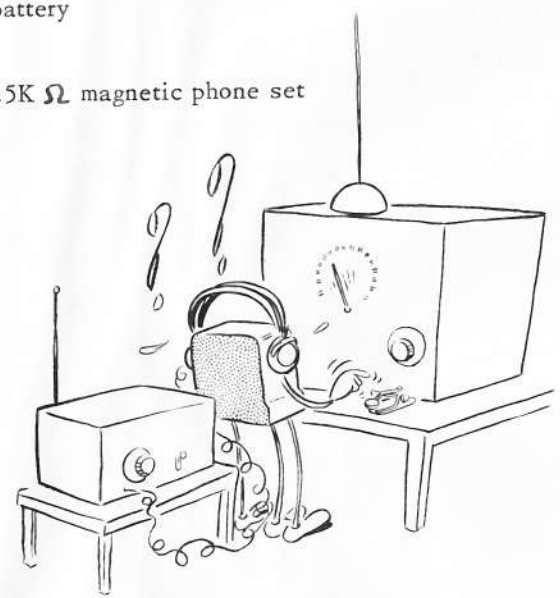
T_r = Hydro-Aire CQ-1 junction transistor

R = 100K Ω resistor – adjust for no signal collector current of 100 μa or less

E = 3 volt battery

SW = Switch

P = 2K – 2.5K Ω magnetic phone set



ELECTRONIC TIMER

The Electronic Timer circuit shown in figure #5 uses one Hydro-Aire (CQ-1) PNP junction type transistor and has many uses where a specific preset time is needed. The time constant can be adjusted by varying R-2. This determines the time that the transistor will conduct and actuate the relay. Low current drain insures long battery life as well as greater reliability and longer transistor life. Component parts are all standard and are readily available at all radio supply houses.

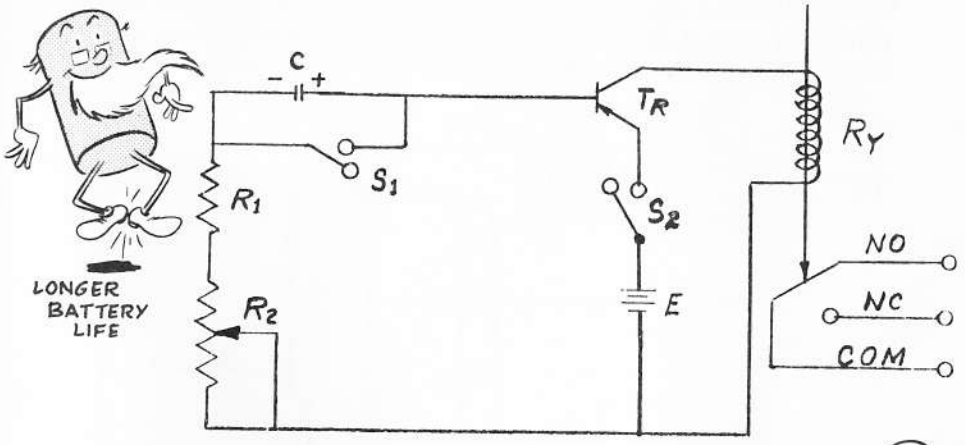


Figure 5

T_r = Hydro-Aire CQ-1, P-N-P Junct. Trans.

R_1 = 2500 Ω, ½ Watt, Carb. Res.

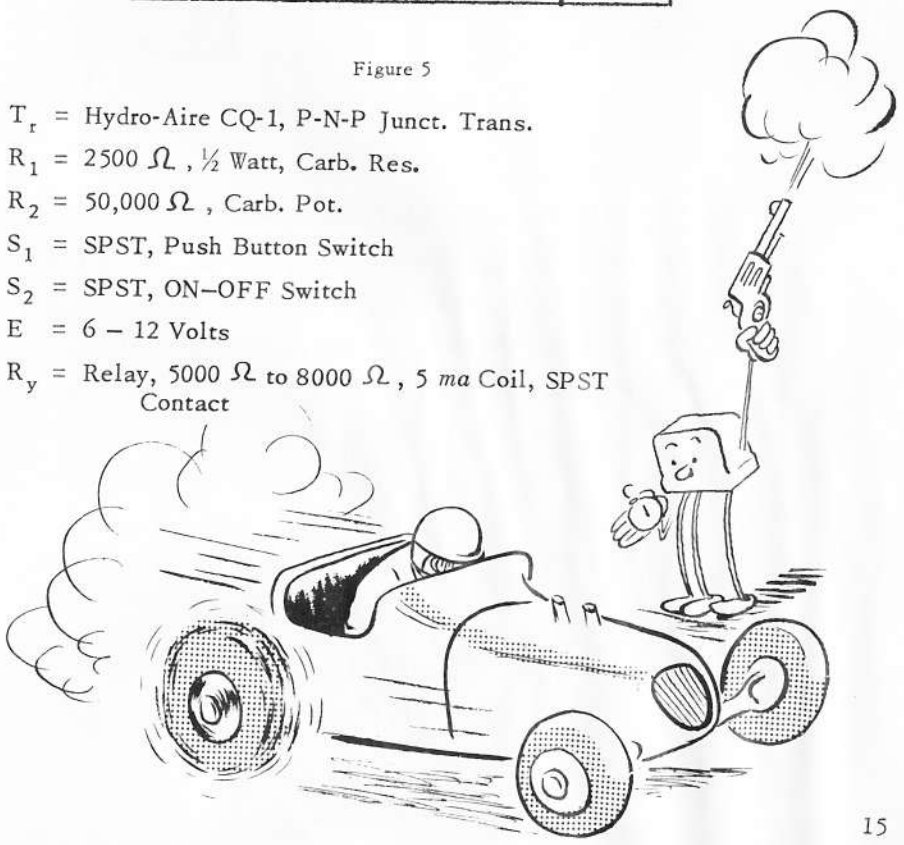
R_2 = 50,000 Ω, Carb. Pot.

S_1 = SPST, Push Button Switch

S_2 = SPST, ON–OFF Switch

E = 6 – 12 Volts

R_y = Relay, 5000 Ω to 8000 Ω, 5 *ma* Coil, SPST Contact



RELAY CONTROL CIRCUIT

Figure #6 is a schematic for a relay control circuit using the same general basic design concept as depicted in figure #5. The circuit set forth below permits use of an AC signal to control the relay. This signal can be of any audio frequency from 10 cycles to 70 KC with the most efficient operating point falling in the range of 1 KC. The relay coil resistance is approximately 5000 ohms and must have at least a 5 ma current rating as it is used as a collector load for the transistor.

This relay control circuit has many applications and the component values can be varied somewhat to adjust to the different applications.

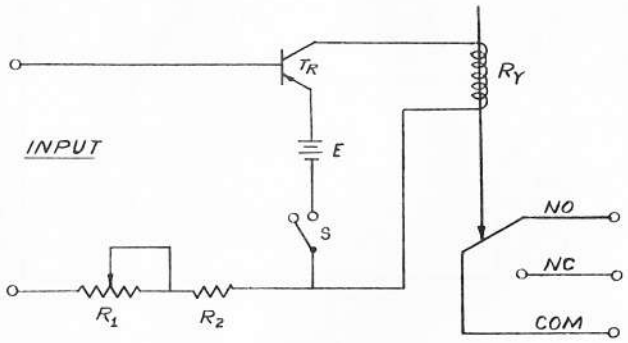


Figure 6

T_r = Hydro-Aire CQ-1, P-N-P Junct. Trans.

R_1 = 200,000 Ω Carb. Pot.

R_2 = 5000 Ω , ½ Watt, Carb. Res.

E = SPST, ON–OFF Switch

R_y = Sensitive Relay (5000 Ω , 5 *ma*, Coil)

ELECTRONIC TIME GENERATOR

The Electronic Time Generator shown in figure #7 is designed to deliver a sawtooth wave at a slow repetition rate. The frequency of the sawtooth wave can be varied by changing potentiometer R2. An audio output transformer primary, used as a collector load, and taps on the secondary of the transformer, are used to feed back part of the signal through a 250 mfd capacitor to the transistor base. The output can be used as a trigger for various circuits as it has sufficient amplitude and is very stable.

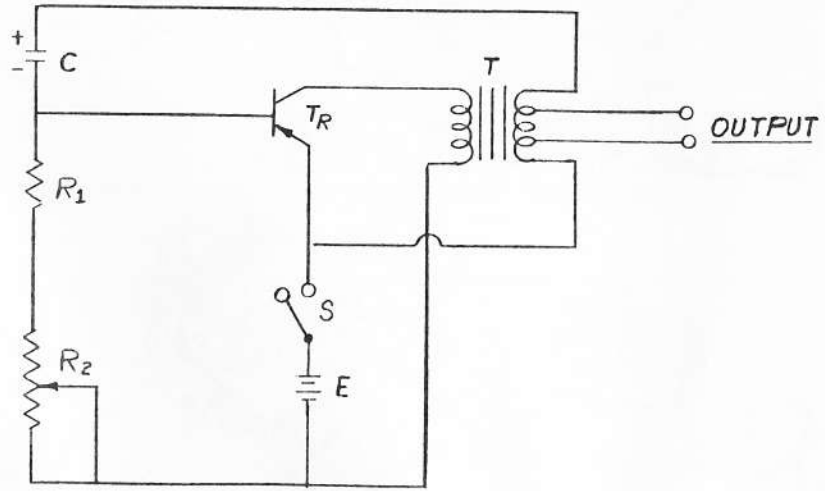


Figure 7

T_r = Hydro-Aire CQ-1, P-N-P Junct. Trans.

C = 250 *mfd* , 20 Volt Electrolytic Capacitor

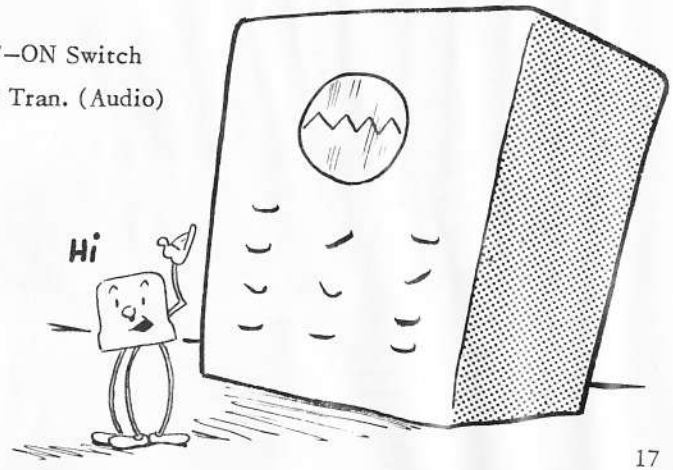
R_1 = 1000 Ω , ½ Watt Carbon Res.

R_2 = 10 MEGOHM Carbon Pot.

E = 6 – 15 Volt

S = SPST – OFF–ON Switch

T = Univ. Output Tran. (Audio)



AUDIO OSCILLATORS USING HYDRO-AIRE PNP JUNCTION TYPE TRANSISTORS

Many people have attempted to build a transistor oscillator and have found that it did not work. Several factors make the design of a transistor oscillator different from its vacuum tube equivalent. Vacuum tubes draw heavy current when first turned on and by so doing shock their circuits into oscillation. Unlike its vacuum tube counterpart, the transistor does not have the self-starting feature. Therefore, this has to be taken care of in the circuit design. The transistor must also be made DC stable or it may lock itself into an inoperative condition. However, if the circuit design is good and the transistor is operated within its specifications, it is a very stable and efficient oscillator. The Audio Oscillator circuit shown in Figure #8, using one Hydro-Aire PNP junction type transistor (CQ-1), is one of several oscillators developed by Hydro-Aire engineers. With minor modifications, frequency and voltage output can be varied considerably.

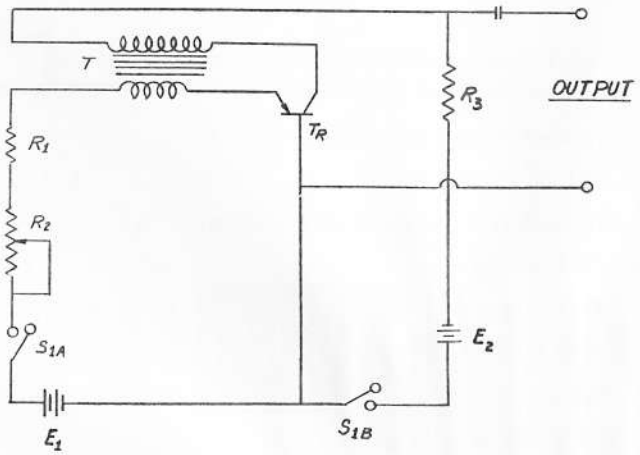


Figure 8

T = 3:1 Audio Transformer

T_r = Hydro-Aire CQ-1, P-N-P Junct. Trans.

R_1 = 2000 Ω , ½ Watt Carb. Res.

R_2 = 1500 Ω , 2 Watt Carb. Pot.

R_3 = 1000 Ω , ½ Watt Carb. Res.

S_1 = DPST, ON–OFF Switch

E_1 = 1.5 Volt

E_2 = 12 Volt

C = 4 *mfd*, 10 Volt Electrolytic Capacitor

FIELD STRENGTH METER

Still another version of our figure #2 diode rectifier receiver is shown below. Construction details are straightforward. The DX enthusiast will find this field strength meter a handy gadget for keeping tabs on the operating efficiency of that all-important beam antenna.

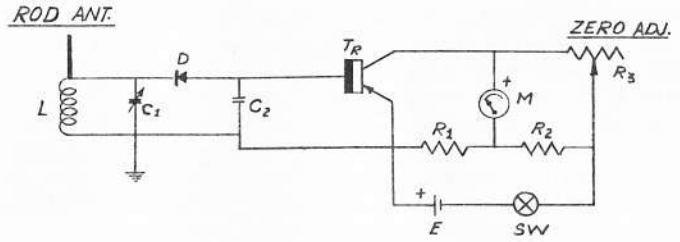


Figure 9

L, C_1 = Coil L and variable capacitor C_1 are chosen for resonance at the transmitter carrier frequency

D = Hydro-Aire germanium diode IN 56A

C_2 = .001 μf capacitor

T_r = Hydro-Aire CQ-1 junction transistor

R_1 = 500 Ω resistor

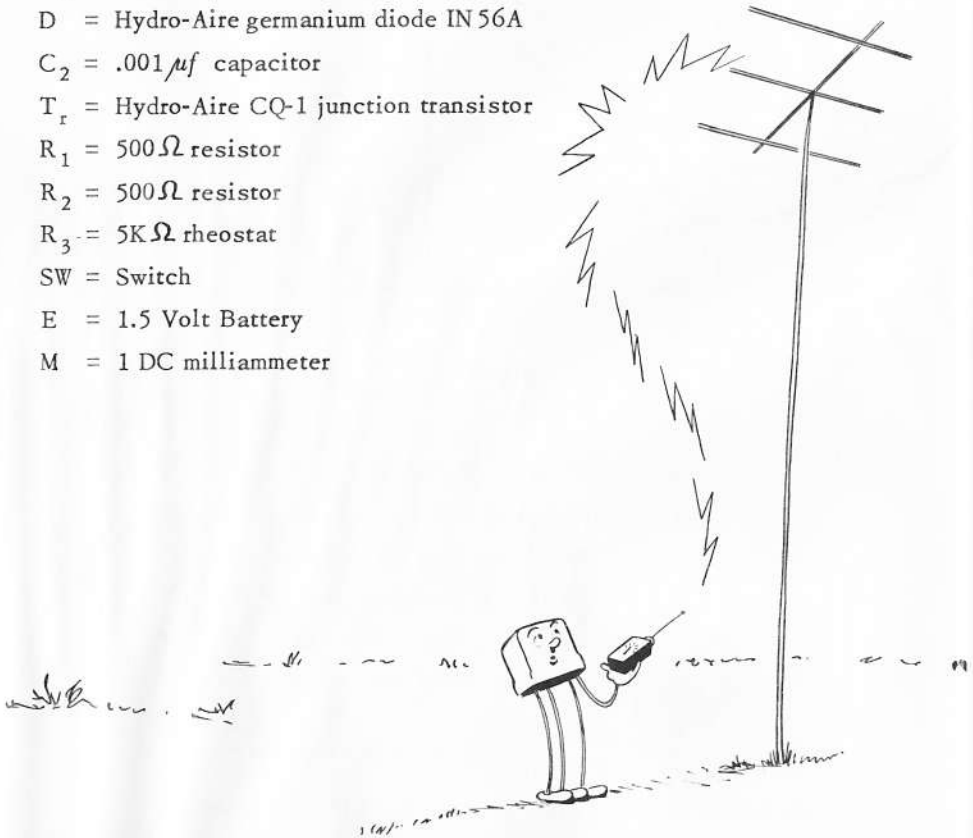
R_2 = 500 Ω resistor

R_3 = 5K Ω rheostat

SW = Switch

E = 1.5 Volt Battery

M = 1 DC milliammeter



LITHO. U.S.A.